

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**  
(Chapter II of the Patent Cooperation Treaty)  
(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference 114160 EJH	<b>FOR FURTHER ACTION</b>	See Form PCT/IPEA/416
International application No. <b>PCT/AU2005/000052</b>	International filing date ( <i>day/month/year</i> ) 17 January 2005	Priority date ( <i>day/month/year</i> ) 15 January 2004
International Patent Classification (IPC) or national classification and IPC  Int. Cl.  <b>C02F 1/44</b> (2006.01) <b>B01D 61/08</b> (2006.01)		
Applicant <b>CRISALIS INTERNATIONAL PTY LTD et al</b>		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
  - a. ☒ (*sent to the applicant and to the International Bureau*) a total of 5 sheets, as follows:
    - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
    - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
  - b. ☐ (*sent to the International Bureau only*) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:

<input checked="" type="checkbox"/> Box No. I	Basis of the report
<input type="checkbox"/> Box No. II	Priority
<input type="checkbox"/> Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
<input type="checkbox"/> Box No. IV	Lack of unity of invention
<input checked="" type="checkbox"/> Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
<input type="checkbox"/> Box No. VI	Certain documents cited
<input type="checkbox"/> Box No. VII	Certain defects in the international application
<input type="checkbox"/> Box No. VIII	Certain observations on the international application

Date of submission of the demand 14 October 2005	Date of completion of this report 01 January 2006
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer  <b>Adrian Gillmore</b> Telephone No. (02) 6283 2125

**Box No. I Basis of the report**1. With regard to the **language**, this report is based on:☒ The international application in the language in which it was filed☐ A translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of:☐ international search (under Rules 12.3(a) and 23.1 (b))☐ publication of the international application (under Rule 12.4(a))☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):☐ the international application as originally filed/furnished☒ the description:pages **1-19** as originally filed/furnished

pages\* received by this Authority on \_\_\_\_\_ with the letter of

pages\* received by this Authority on \_\_\_\_\_ with the letter of

☒ the claims:

pages as originally filed/furnished

pages\* as amended (together with any statement) under Article 19

pages\* **20-24** received by this Authority on **14 October 2005** with the letter of the same

pages\* received by this Authority on \_\_\_\_\_ with the letter of

☒ the drawings:

pages as originally filed/furnished

pages\* received by this Authority on \_\_\_\_\_ with the letter of

pages\* received by this Authority on \_\_\_\_\_ with the letter of

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.3. ☐ The amendments have resulted in the cancellation of:☐ the description, pages☐ the claims, Nos.☐ the drawings, sheets/figs☐ the sequence listing (*specify*):☐ any table(s) related to the sequence listing (*specify*):4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).☐ the description, pages☐ the claims, Nos.☐ the drawings, sheets/figs☐ the sequence listing (*specify*):☐ any table(s) related to the sequence listing (*specify*):

\* If item 4 applies, some or all of those sheets may be marked "superseded."

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.  
PCT/AU2005/000052**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Claims 1-28	YES
	Claims	NO
Inventive step (IS)	Claims 1-28	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-28	YES
	Claims	NO

**2. Citations and explanations (Rule 70.7)**

D1: US 6348148

D2: US 6139750

Claim 1 and 11 each define an in-situ desalination device for a borehole using reverse osmosis membranes with a sealing device in the borehole. The concentrate is delivered to the other side of the borehole separated by the sealing device from the reverse osmosis apparatus. D1 and D2 each disclose a desalination apparatus but do not disclose these features.

Therefore, claims 1-28 are novel and inventive over each of D1 and D2.

All claims are industrially applicable.

Claims

1. An in situ desalination apparatus adapted in use to be used located in a borehole containing groundwater from a subterranean aquifer, the desalination apparatus comprising:
  - a sealing means for separating the borehole into upper and lower portions;
  - a reverse osmosis unit comprising a reverse osmosis medium;
  - an inlet for the reverse osmosis unit located on one side of the reverse osmosis medium, in use the inlet to be located below the upper surface of the groundwater and in the upper portion of the borehole with respect to the sealing means;
  - a concentrate outlet for the reverse osmosis unit opening to the same side of said reverse osmosis medium as the inlet, for delivering concentrate to the lower portion of the borehole with respect to the sealing means;
  - a permeate outlet on the other side of the reverse osmosis medium from said inlet;
  - a delivery line in fluid communication with the permeate outlet in use extending from the body of water; and
  - a pump for delivering groundwater to the inlet.
2. A desalination apparatus according to claim 2 wherein the sealing means is adapted to allow the apparatus to be removably inserted into a borehole casing.
3. A desalination apparatus according to claim 2 wherein the sealing means is expandable from a state receivable within the casing to an expanded state sealed against the casing.
4. A desalination apparatus according to claim 2 or claim 3 wherein the sealing means comprises an inflatable packer which can be selectively inflated to seal against the casing.
5. A desalination apparatus according to any one of claims 2 to 4 wherein the casing comprises a wall at least a portion of which is screened allowing water to flow therethrough.

6. A desalination apparatus according to claim 5 wherein the sealing means seals against the casing to separate the borehole into an upper part wherein the casing comprises a screened wall portion for admitting water from the aquifer and a lower part wherein the casing comprises a screened wall portion to allow the saline concentrate to dissipate within the aquifer.
7. A desalination apparatus according to claim 6 wherein the casing comprises two screened portions axially spaced along the length of the casing.
8. An *in situ* desalination apparatus as claimed in any one of the previous claims wherein the permeate outlet is associated with a pumping means adapted to extract permeate passing through the reverse osmosis medium.
9. An *in situ* desalination apparatus as claimed in any one of the previous claims wherein the permeate outlet is vented to the atmosphere.
10. An *in situ* desalination apparatus as claimed at any one of the preceding claims wherein the pump is a common pump connected to the inlet and the permeate outlet through a set of valves whereby said common pump is able to introduce said water into the inlet and deliver permeate from the permeate outlet through a controlled activation of the valves.
11. An *in situ* desalination apparatus comprising  
a length of tubular borehole casing adapted in use to be located in a borehole the casing comprising at least a portion of screened wall for allowing the passage of water through the casing;  
a sealing means for sealing against the borehole casing and dividing the borehole within the casing into an upper portion and a lower portion, the sealing means and borehole casing cooperating to allow flow of ground water through a screened portion into at least the upper portion;  
a reverse osmosis unit supported within the bore hole by the sealing means the reverse osmosis unit having a reverse osmosis medium;  
an inlet for the reverse osmosis unit providing communication between the upper portion of the interior of the casing and one side of the reverse osmosis medium;

a concentrate outlet for the reverse osmosis unit providing communication between the one side of the reverse osmosis medium and the lower portion of the borehole;

5 a permeate outlet for the reverse osmosis unit opening on the other side of the reverse osmosis medium;

a delivery line in communication with the fluid outlet line extending from the body of water; and

10 a pump for delivering water under pressure from the upper portion of the interior of the casing to the inlet, whereby the pressure differential created across the reverse osmosis medium facilitates reverse osmosis.

12. An *in situ* desalination apparatus according to claim 11 wherein the tubular borehole casing includes a portion of screened wall in the upper portion of the casing with respect to the sealing means and a screened portion in the lower  
15 part with respect to the sealing means.

13. An *in situ* desalination apparatus according to claim 11 wherein the screened wall is continuous.

20 14. An *in situ* desalination apparatus according to claim 11 wherein there are at least two portions of screened wall at axially spaced locations along the length of the casing.

25 15. An *in situ* desalination apparatus according to claim 11 further comprising a groundwater delivery pump for providing a flow of groundwater through a screened portion into an upper portion of the borehole in the casing.

30 16. A desalination apparatus according to claim 11 wherein the sealing means is expandable from a state receivable within the casing to an expanded state sealed against of the casing.

35 17. An *in situ* desalination apparatus as claimed at claim 11 wherein the permeate outlet is associated with a pumping means adapted to extract permeate passing through the reverse osmosis medium.

18. An *in situ* desalination apparatus as claimed at claim 17 wherein the permeate outlet is vented to the atmosphere.

19. An *in situ* desalination apparatus as claimed at any one of claims 11 to 18 wherein the concentrate outlet is controlled to maintain pressure of predetermined magnitude sufficient for reverse osmosis.

20. An *in situ* desalination apparatus as claimed at any one of claims 11 to 19 wherein the sealing means comprises an inflatable packer which can be selectively inflated to provide the sealing against the casing.

21. An *in situ* desalination apparatus as claimed at any one of claims 11 to 20 wherein the concentrate outlet is controlled by an exhaust valve which is closed upon the pressure at the one side of the reverse osmosis medium falling below a pressure of determined magnitude which is at least equal to the desired operating pressure of the reverse osmosis unit.

22. An *in situ* desalination apparatus as claimed at any one of the previous claims wherein the reverse osmosis medium, pump and sealing means together comprise a unit which is removable from the casing.

23. An *in situ* desalination apparatus as claimed at claims 11 to 22 wherein the screened portion comprises two screened portions at axially spaced locations along the length of the casing and the sealing means in use engages the inner face of the casing between the two screened portions such that the upper portion communicates with the upper most screen and is sealed from the lower screen.

24. An *in situ* desalination apparatus according to claim 11 comprising a borehole in an aquifer comprising a water table, a borehole casing lining the borehole, an assembly comprising the reverse osmosis unit, the pump and the sealing means adapted to be removably inserted in the borehole casing and retained therein by radial expansion of the sealing means;

25. A method of desalination of groundwater in an aquifer disposed below a ground surface comprising:

providing a borehole in the ground surface extending into the aquifer;

providing a reverse osmosis unit according to any one of claims 11 to 24 and locating the reverse osmosis unit in a borehole such at (a) sealing means separates water within the borehole casing into upper and lower portions; (b) the inlet is located below the upper surface of the body of groundwater and in the upper  
5 portion with respect to the sealing means; and (c) the concentrate outlet for the reverse osmosis unit opens to the lower portion of the borehole with respect to the sealing means;

pumping ground water from the upper portion of the borehole;

providing a permeate outlet for delivering permeate to the ground surface;

10 collecting permeate at the ground surface; and

delivering concentrate to the concentrate outlet in the lower portion of the borehole so that the concentrate descends through the aquifer.

26. A method according to claim 25 wherein the concentrate is retained below  
15 the water surface and is allowed to descend through the aquifer from the concentrate outlet.

27. A method according to claim 26 wherein the desalination is conducted under ambient conditions within the borehole.

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28. A method according to claim 28 wherein the concentrate is isolated from sunlight and air from the surface.